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Name: ~~KEY~~ KEY

Physics 2A
Winter 2010
Exam 2

① F.B 1 ②
FB 2 ②

$a = 2.45 m/s^2$ ④

$T = 36.8 N$ ②

② FB ②
FB ②
FB ②

$u_k = 0.32$ ④

③ a) $T = 9.0 s$ ③

b) FB_{TOP} ④
FB_{bot} ④

$n_{TOP} = 343 N$ ②
$n_{bot} = 1029 N$ ②

④ Diagram ②
F.B ②

$W_y + W_s = 0$ ②

$X_{max} = 21.8 cm$ ④

1. Consider the Atwood's Machine system shown below. Assume massless, frictionless pulley. (10 pts)

m_1 3.0 kg

m_2 5.0 kg

a) Calculate the acceleration of the blocks. Which direction does the 3.0 kg move?
b) Calculate the tension in the string.

$m_2 \overset{\circ}{:} \ \Sigma F_y = m_2 g - T = m_2 a$

$m_1 \overset{\circ}{:} \ \Sigma F_y' = T - m_1 g = m_1 a$

$(m_2 - m_1)g = (m_1 + m_2)a$

a) $\quad a = \dfrac{(m_2 - m_1)g}{m_1 + m_2} = \left(\dfrac{5-3}{5+3}\right)9.8 = \boxed{+2.45 \ m/s^2}$ ④

m_1 moves up $\overset{\circ}{:}$

b) $\quad T = m_2 g - m_2 a = m_2(g-a) = \boxed{36.8 \ N}$ ②

2. For the system shown below, when the blocks are released from rest, they acquire an acceleration of 0.70 m/s². Calculate the coefficient of kinetic friction between the block and the table-top. (10 pts)

① $\Sigma f_y = T_1 - Mg = Ma$

② $\Sigma F_x = T_2 - T_1 - f_k = 2Ma$

③ $\Sigma f_{y''} = 2Mg - T_2 = 2Ma$

$$Mg - f_k = 5Ma$$

$f_k = \mu_k n$
$\quad = \mu_k 2Mg$

$$\cancel{M}g - \mu_k 2\cancel{M}g = 5\cancel{M}a$$

$$g - 5a = 2\mu_k g$$

$$\mu_k = \frac{g - 5a}{2g} = \boxed{0.32}$$
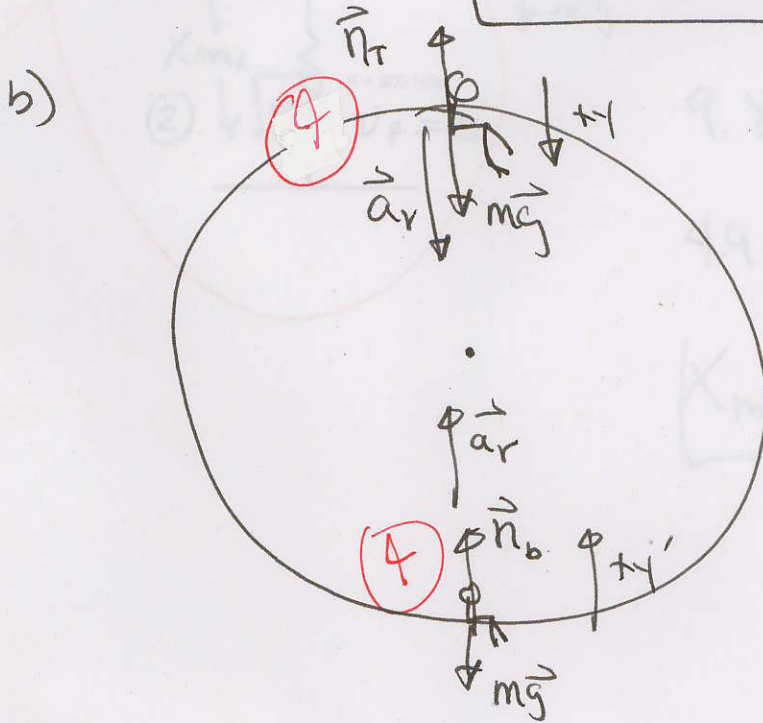
④

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3. A 70 kg person goes on a Ferris Wheel ride in a vertical circle of radius 10.0 m and moving at a constant speed of 7.0 m/s. (15 pts)
   a) Calculate the period of rotation.
   b) Calculate the magnitude and direction of the normal force exerted on the person by the seat at the **highest** and **lowest** point on the ride.

a) $v = \dfrac{2\pi r}{T} \implies T = \dfrac{2\pi r}{v} = \dfrac{2\pi(10)}{7}$

$$\boxed{T = 9.0\,s}$$ (3)

b)

TOP

$\sum F_y = mg - n_T = m\dfrac{v^2}{r}$

$n_T = mg - \dfrac{mv^2}{r}$

$n_T = m\left(g - \dfrac{v^2}{r}\right)$

$$\boxed{n_T = 343\,N}$$ (2)
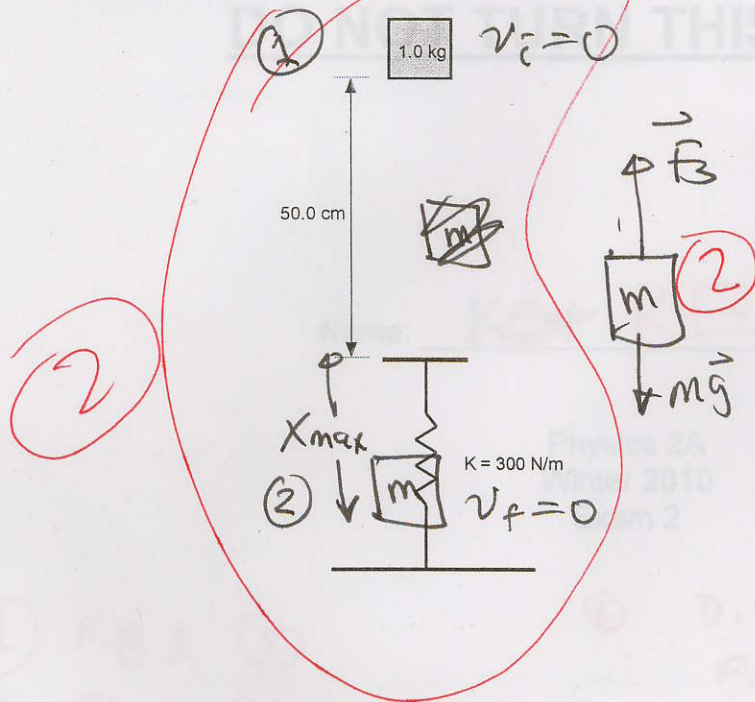
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$\sum F_{y'} = n_b - mg = m\dfrac{v^2}{r}$

$n_b = m\left(g + \dfrac{v^2}{r}\right)$

$$\boxed{n_b = 1029\,N}$$ (2)

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4. A 1.0 kg block is released from rest from a height of 50.0 cm above the top end of a vertical spring (K = 300 N/m) in its equilibrium position. See figure below. Use the _Work-Kinetic Energy Theorem_ to calculate the maximum compression of spring. (10 pts)

$$W_{net} = \cancel{k_f} - \cancel{k_i}$$

$$W_g + W_s = 0 \quad ②$$

$$mg(0.50 + X_{max}) + \frac{1}{2} K X_i^2 - \frac{1}{2} K X_f^2 =$$

$$9.8(0.50 + X_{max}) - \frac{1}{2}(300) X_{max}^2 =$$

$$4.9 + 9.8 X_{max} - 150 X_{max}^2 = 0$$

$$\boxed{X_{max} = 0.216 \, m}$$

$$\boxed{21.6 \, cm} \quad ④$$

$v_i = 0$

50.0 cm

X_{max}

$v_f = 0$

K = 300 N/m

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